Several of the problems on this assignment are repeats. Use nets!

1. Show that a topological space in X is Hausdorff if and only if every convergent net in X has exactly one limit.

2. Consider the product space $X \times Y$. Find (and prove) a condition in terms of coordinate functions that characterizes convergence of nets in the product. Does your condition also work for an arbitrary product?

3. Show that a space X is Hausdorff if and only if the diagonal in $X \times X$ is closed.

4. Let G be a topological group and let H be a subgroup. Show that $\overline{H}$ is a subgroup.

5. Suppose X is a space and Y is compact and Hausdorff. Show that a function $f : X \to Y$ is continuous if and only if the graph of f is closed.

6. Show that the homeomorphism group of a connected manifold acts transitively. In other words, show that if M is a connected manifold, then for any two points p and q in M there is a homeomorphism $\psi : M \to M$ such that $\psi(p) = q$.